

Research Article

Epidemiological Profile of Acute Typical Bacterial Pneumonia at The National Reference University Hospital Center of N'Djamena: Risk Factors and Antibiotic Resistance

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Abstract

Acute bacterial pneumonias are non-tuberculous bacterial infections of the lung. They constitute a common pathology in children and adults.

The objective of this study was to promote microbiological diagnosis for optimal treatment in terms of antibiotic therapy.

This is a prospective observational and analytical study running from June 2022 to February 2023 based on cytotuberciological examinations of sputum from patients of all genders and ages admitted to the pulmonology and infectious diseases department of the National Reference University Hospital Center (CHURN) from N'Djamena. The isolation, identification and antibiogram of the bacteria responsible for acute pneumonia were carried out according to standard clinical microbiology techniques.

Of the 207 patients receiving sputum cytotuberciological screening, 121 bacterial agents were isolated, representing a prevalence of bacterial pneumonia of 58.45%. The most isolated bacterial strains were Staphylococcus (45.25%) followed by Streptococcus pneumoniae (34%) and Escherichia coli (10%). Significant differences were observed in terms of predominance of participation of men in the survey compared to women, the origin of patients from N'Djamena and Provinces, schooled and non-schooled patients and Gram-positive and Gram-negative bacteria with the probabilities of 0.01, 0.001, 0.01 and 0.001 respectively. The average age of the patients was 40.9 years with a sex ratio of 1.9. The antecedents associated with pneumonia were HIV infection, respiratory diseases, diabetes, smoking, alcoholism and cough with the proportions of 8.7%, 7.7%, 4.8%, 11.1% and 72.5 % respectively. The sensitivity of isolated bacterial strains gradually decreases from aminopenicillins to 3rd generation cephalosporin. The proportions of resistance were completely variable. Among Staphylococcus, resistance was very remarkable with erythromycin (68%), oxacillin (64.51%), ciprofloxacin (60%) and 96.15%

of Staphylococcus were sensitive to fusidic acid. Oxacillin and amoxicillin clavulanic acid were almost inactive. Resistance of Escherichia coli remains high with amoxicillin clavulanic acid (66.7%) and ceftazidime (83.3%). Pseudomonas aeruginosa was 100% susceptible to ceftazidime. This study not only revealed the high prevalence of bacterial pneumonia and high resistance of the antibiotics tested. The importance of the sensitivity test allows the adaptation of antibiotic therapy to microbiological results.

Keywords: Acute Bacterial Pneumonia; Antibiotic Resistance; Risk Factors; CHURN; Chad

Introduction

Pneumonitis are lower respiratory diseases having infectious, interstitial, or even immunological origins [1,2]. Several microbial agents are involved, including bacteria. The main bacteria responsible are: *Streptococcus pneumoniae*, *Haemophilus influenzae*, *Klebsiella pneumoniae*, *Legionella pneumophila*, *Staphylococcus aureus*, *Pseudomonas aeruginosa*, *Mycoplasma pneumoniae*, *Chlamydophila pneumoniae* and *Escherichia coli* [3]. The signs and symptoms associated with pneumonia are fever, cough with or without sputum, chest pain, dyspnea, tachypnea and rales on auscultation [4]. Species other than *Mycoplasma pneumoniae* and *Chlamydophila pneumoniae* can cause septicemia, lung abscess, empyema and even death. These complications are more common in people with a chronic illness, in very young or very old people [5]. These are very common pathologies in developing countries, constituting a public health problem [6]. Despite progress made in treatment, bacterial pneumonia remains one of the main causes of mortality worldwide [7]. This mortality is aggravated by the confrontation with two major problems of care: the orientation of the patient at the end of his stay in the department and the choice of probabilistic antibiotic therapy [8]. The World Health Organization (WHO) estimates the prevalence of pneumonia at 450 million cases per year, with 3.5 million deaths worldwide. Thus, pneumonia represents the sixth cause of death in the world and also the leading cause of death of infectious origin in the United States (35 to 40% of deaths) and in Western Europe (22-57% of deaths) [9]. The responsible germs are very varied with a predominance of pneumococcus, the proportion of resistant strains of which is increasing more and more to reach an alarming level today [10]. In developing countries with limited resources, the etiological diagnosis of these pneumonias is expensive and often impossible. In countries with a high technical plateau, the etiology is only determined in 40 to 60% of cases [11]. Therefore, antibiotic therapy is systematic as soon as the diagnosis is made. But it is necessary to adapt antibiotic therapy to microbiological results [12]. The appearance and development of strains of pneumococci with reduced sensitivity or resistance to penicillin have led to questions about the most appropriate therapeutic approach.

In France, pneumococcal resistance to penicillin G is constantly increasing (1% to 43%) and is extending in parallel with other antibiotics (macrolides (15%) and tetracyclin (12%)). Prior use of antibiotics in the three months preceding pneumonia as well as the presence of a debilitated condition (cancer, alcoholism, etc.) appeared to be resistance factors. Strains of *H. influenzae* producing beta-lactamases and therefore resistant to amoxicillin, have increased in recent years. In Europe, Slovenia, Spain and France are the most affected by this problem with a respective frequency in 1997 of 75.37% and 30% while Hungary, Holland, Germany and Italy have respective rates of 4%, 5%, 7% and 9%. *H. influenzae* is only moderately susceptible to macrolides and resistance to tetracyclin or fluoroquinolones is poorly reported [13-15]. The place of the new quinolones (in France levofloxacin), cited in the latest American and French recommendations, remains to be clarified. Although they have the advantage of covering all the bacteria responsible for chronic pneumonia (including pneumococcus resistant to penicillin G), their large-scale use raises concern about the rapid risk of resistance emergence [16]. This resistance varies greatly from one country to another and even from one region to another, hence the interest in knowing the local epidemiology in Chad.

In Chad, few studies have been devoted to acute bacterial pneumonia, but the infection was frequent in children with a prevalence of 27/1000 live births and 24% of deaths. It was the leading cause of death among children under 5 years of age in 2017 [17,18]. Hence the need to study etiological factors and antibiotic resistance.

The objective of this work is to determine the epidemiology profile of acute typical bacterial pneumonia in patients admitted to the pneumonia and infectious diseases department at CHURN and also to promote the contribution of microbiological diagnosis for optimal management in terms of antibiotic therapy.

Acute typical bacterial pneumonia is one of the most common infectious pathologies, it is responsible for numerous hospitalizations ignored due to lack of microbiological diagnosis in many countries with limited resources. Antibiotic therapy, initially empirical, is a therapeutic emergency and requires dual therapy (Betalactams, macrolide or fluoroquinolone) taking into account the most frequently responsible bacteria (pneumococcus, Gram-negative bacilli (BGN), *Haemophilus*, staphylococci and "atypical", including *Mycoplasma pneumoniae*, *Chlamydophila pneumoniae*, *Legionella* and viruses). It will secondarily be adapted to the micro-organism in question. Pneumococcus remains the most frequently isolated pathogen; it poses a growing problem of resistance to aminopenicillins and other antibiotics, justifying regular epidemiological surveillance.

Material and Methods

Setting, Type and Period of Study

The following services served as a study setting: the bacteriology unit of the Diagnostic Research and Scientific Expertise Laboratory (Labo-ReDES) of the Faculty of Human Health Sciences (FSSH), Reference University Hospital Center National (CHURN). The study was prospective, observational and analytical, spread over a period of one year from June 2022 to January 2023.

Study Population

The study population included any patient of any sex and age, admitted to the pulmonology department and the infectious diseases department of the CHURN presenting symptoms suggestive of infectious pneumonia.

Eligibility Criteria

The possibility of collecting sputum.

Patient Refusal

Antibiotic therapy in progress or in the 2 weeks preceding the sample.

Sampling

The sample size was proportional to the duration of the study, a minimum of 207 samples were analyzed.

Sputum Collection

The sample, which requires impeccable collection technique, will be carried out as follows:

- Explain all procedures to the patient
- Rinse your mouth with mineral water before taking the sample
- Collect morning sputum on an empty stomach obtained after coughing into a sterile bottle
- Make an effort to cough and spit into the sterile container
- Close the bottle carefully
- Send the sample to the laboratory as quickly as possible to avoid the proliferation of commensal bacteria at the expense of fragile bacteria (less than 30 minutes)
- Never keep this sample cold

Macroscopic Observation

The macroscopic examination of sputum consists of observing the appearance of the sputum and examining its qualities. The appearance of the sputum may be mucopurulent, bloody, salivary or mucous.

Microscopic Observation

GRAM Coloring: From the sputum, a mucopurulent or bloody fraction was spread on a slide using a stage loop. Once the smear was dry, it was heat fixed and then stained using the following steps:

- Cover the smear with crystal violet for one minute then rinse with water
- Mordant with Lugol for one minute, then rinse with water
- Discoloration with alcohol
- Recoloring with safranin or fuchsin for a minute, then rinsing with water then drying the slide in the open air
- Observation under an optical microscope with a drop of immersion oil and a $\times 100$ objective
- Gram-positive bacteria remain purple and Gram-negative bacteria take on the color of fuchsin (pink or red)

Study of the Sensitivity of Bacteria Responsible for Pneumonia

Choice of Antibiotics

Antibiotics were chosen based on their prescription for the treatment of pulmonary infections in the pneumonia and infectious diseases departments of CHURN.

Category	Family	Antibiotic/dose	Diameter (mm)		
			Sensitivity	Intermediate	Resistance
	Fusidic acids	Fusidic acid	>32	26-32	<26
	Betalactams	Oxacillin (5 µg)	>14	8-14	<8
		Ceftriaxone	>22	16-22	<16
		AMC (20-10 µg)	>24	18-24	<18
		Ceftazidime (30 µg)	>31	25-31	<25
		Imipenem (10µg)	>32	17-24	<17
	Fluoroquinolones	Ciprofloxacin (5µg)	>22	19-22	<19
	Macrolides	Erythromycin (15 µg)	>22	19-22	<19
	4 Families	8 antibiotics			
- Quality control was carried out using the reference strain <i>E. coli</i> ATCC 25922, <i>Staphylococcus aureus</i> ATCC 29213; <i>Streptococcus pneumoniae</i> ATCC 49619; <i>Haemophilus influenzae</i> ATCC 49766 (CA-SFM, EUCAST; 2016-2022) - AMC: Amoxicillin-Clavulanic Acid					

Table 1: Antibiotics chosen for sensitivity testing.

Culture and Antibigram

The culture was carried out on agar enriched with fresh blood + CO₂, chocolate agar (poly vitex) for pneumococci and streptococci, on Chapman media and chocolate agar for staphylococci, on Hektoen and Mac Conkey agar media for enterobacteria.

The API 20 E, API SPREP, API STAPH galleries (BioMérieux) were used to identify the germs on the basis of their biochemical characters. Gram staining was also performed on strains isolated on solid agar.

The identification of pneumococcal colonies was done based on several criteria. Partial α hemolysis visible on fresh blood agar, catalase negativity and optochin sensitivity ($\approx$ 95% of strains) to differentiate *Streptococcus pneumoniae* from other streptococci. The antibiogram was carried out systematically on all the bacterial strains isolated. It is a method based on the diffusion of paper disks impregnated with antibiotic on agar medium (preferably Mueller-Hinton) but for demanding germs, we used agar enriched with fresh blood + CO₂, chocolate agar (poly vitex) for the antibiogram. The previously dry antibiotic disks, once placed on the agar, absorb a sufficient quantity of water to dissolve the antibiotic which thus gradually diffuses into the medium following the physical laws of molecular diffusion through a gel. In this method there is a direct correlation between the Minimum Inhibitory Concentration (MIC) and the diffusion zone. It is carried out as follows:

- Preparation of the inoculum: From a pure and fresh culture taken on agar medium, prepare a suspension with an opacity equivalent to the 0.5 Mac Farland standard
- Inoculation of the plates: By swabbing, inoculate the colony in the agar. Immerse a sterile swab in standardized inoculum, squeeze it gently on the walls of the tube containing the suspension; then pass it 2 to 3 times over the entire surface of the agar medium in order to obtain homogeneous seeding and confluent colonies
- Drying the boxes: Allow the boxes to dry for 10 minutes before placing the discs
- d) Arrangements of the antibiotic disks: Place the disks using a dispenser or pliers, pressing them lightly and place them at least 15 mm from the periphery of the box so that the areas of inhibition do not overlap. A concentration gradient of the antibiotic is thus formed around each disc
- Incubation: Incubate the agar plates at 37°C for 24 hours
- Reading the diameter of the inhibition zones: No growth appears when the antibiotic is present at inhibitory concentrations

and is sensitive to the strain. It is then possible to measure, using a caliper, the diameter of the inhibition zone which is directly proportional to the minimum inhibitory concentrations

- Interpretation: After measuring the inhibition zone translated by a clear zone around the antibiotic, we deduce that the larger the diameter of the zone, the more sensitive the antibiotic

Data Analysis

Microsoft Office Excel and Microsoft Office World 2016 were used for data entry. The chi-square test was used to compare the qualitative variables at the significant rate set at 5%.

Ethics Declaration

This study was approved by the ethics committee of the National Reference University Hospital Center (CHURN) of N'Djamena. All samples and clinical information from participants were obtained in accordance with protocols approved by the ethics committee and informed consent was obtained from study participants or legal guardians of minor participants before the start of the study. Patient information was managed in strict compliance with the Declaration of Helsinki.

Results

Distribution of Patients by Sex

Of the 207 survey participants, males represented 136 (66%) compared to 71 (34%) females ($\chi^2 = 6.191 > \chi^2_{0.01} = 3.84$, $q = 0.01$, df (degree of freedom) = 1, a significant difference in favoring the predominance of male patients). The sex ratio was 1.9.

Distribution of Patients According to Age Group

The average age of the patients was 40.9 years with extremes of 9 and 96 years.

The age group of 25 to 34 years old was the most represented (19.8%) followed by 35 to 44 years old (17.9%), 45 to 54 years old (16.9%), 18 to 24 years old (16.4%) and 65 and over (12.1%).

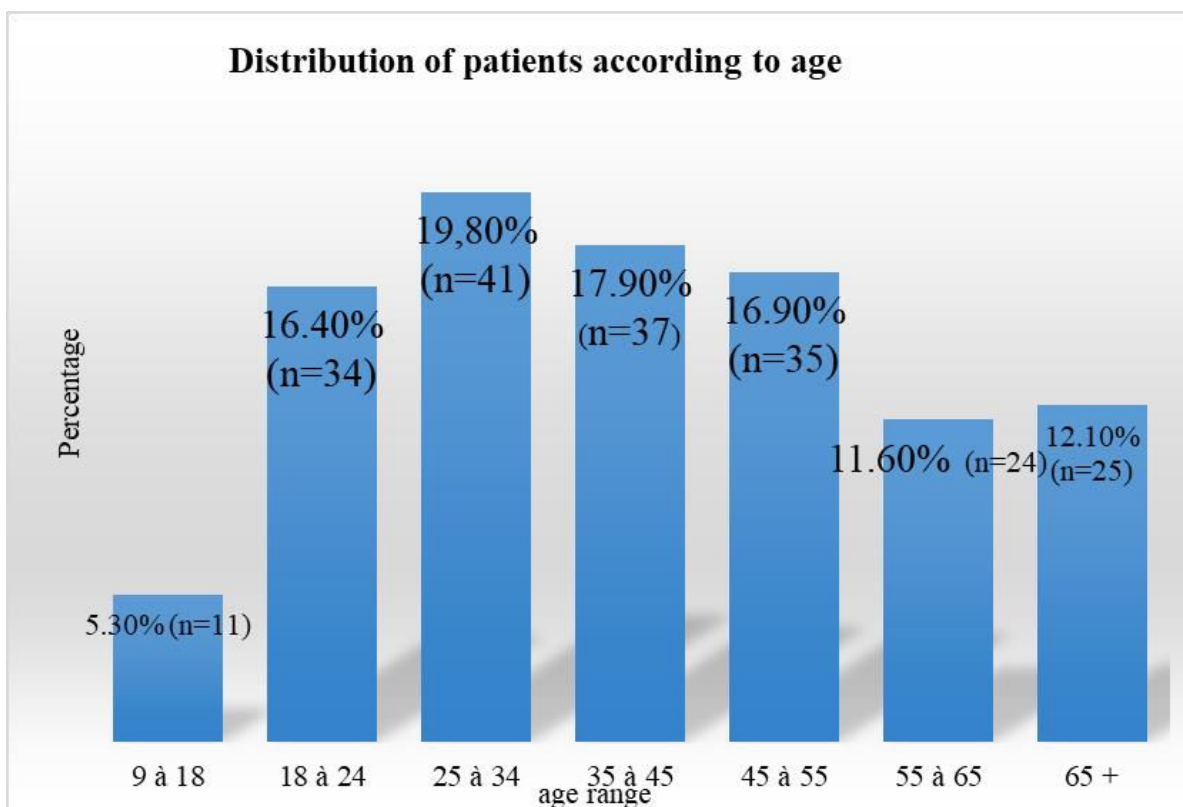


Figure 1: Distribution of patients by age group.

Distribution of Patients According to Associated History

Table 2 shows the distribution of patients according to the history associated with bacterial pneumonia. Patients with no associated history accounted for (59.9%) followed by smoking (11.1%), HIV (8.7%) and respiratory disease (7.7%).

Associated Antecedents	Effective	%
VIH	18	8.7
Hepatitis B, C, E	1	0.5
Renal failure	5	2.4
Respiratory disease	16	7.7
Alcoholism	10	4.8
Diabetes	10	4.8
Smoking	23	11.1
No antecedent	124	59.9
Total	207	100
% = percentage		

Table 2: Distribution of patients according to associated history.

Distribution of Patients According to Origin

The patients came from N'Djamena with 165 (79.7%) compared to 42 (20%) from the provinces ($\chi^2 = 14.386 > \chi^2_{0.05, 1} = 3.84$, $p = 0.001$, $df = 1$, a significant difference in favor of patients predominantly from N'Djamena).

Distribution of Patients According to Profession

Table 3 shows the distribution by occupation. Housewives represented (27.5%) followed by traders (24.2%), resourceful people (19.3%) and soldiers (11.6%).

Profession	Effective	%
Trader	50	24.2
Civil servant	20	9.7
Military	24	11.6
Household	57	27.5
Unemployed	11	5.3
Resourceful	40	19.3
Driver	1	0.5
Artisan	1	0.5
Pupil/Student	3	1.4
Total	207	100

Table 3: Distribution according to the socio-professional status of patients.

Distribution of Patients According to Marital Status

Married people accounted for 127 (61.3%) followed by single people 65 (31.4%) and widowed people 12 (6%) (Fig. 2).

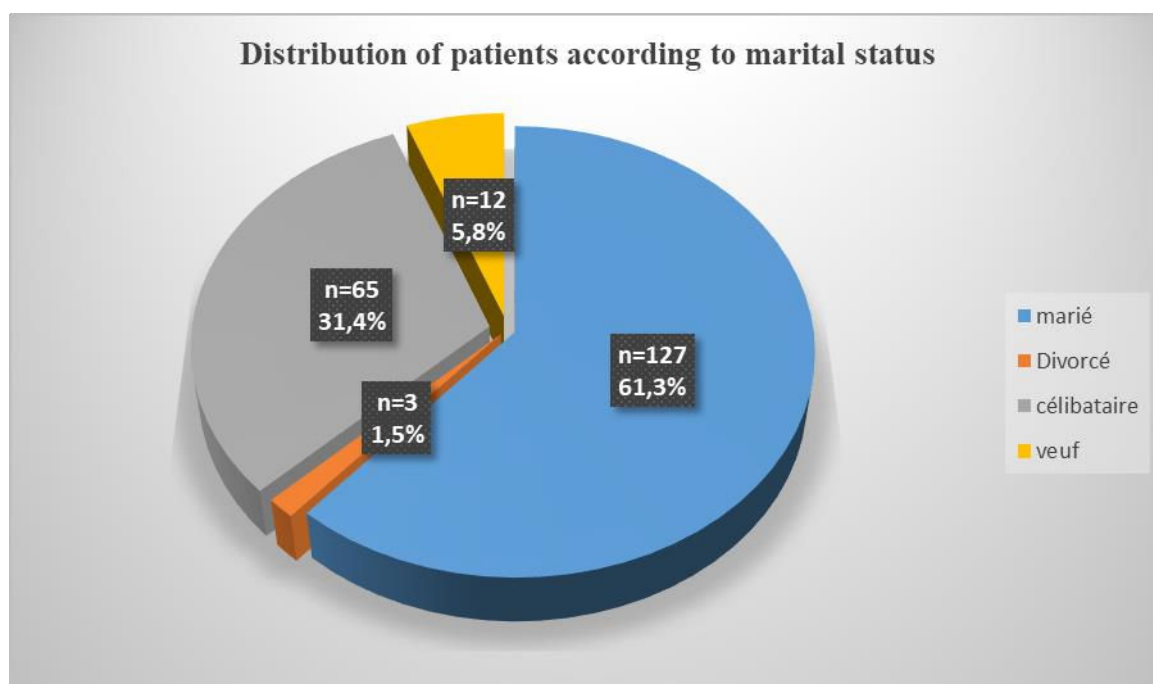


Figure 2: Distribution of patients according to marital status.

Distribution of Patients According to Level of Study

Patients with no education and secondary level accounted for (33%) followed by primary level 40 (19%) and higher level 30 (15%) respectively. Of the 207 patients surveyed, 138 (67%) were in school and 69 (33%) were not in school ($\chi^2 = 6.44 > \chi^2_{0.01, 1}$, a significant difference in the predominance of patients schooled) (Fig. 3).

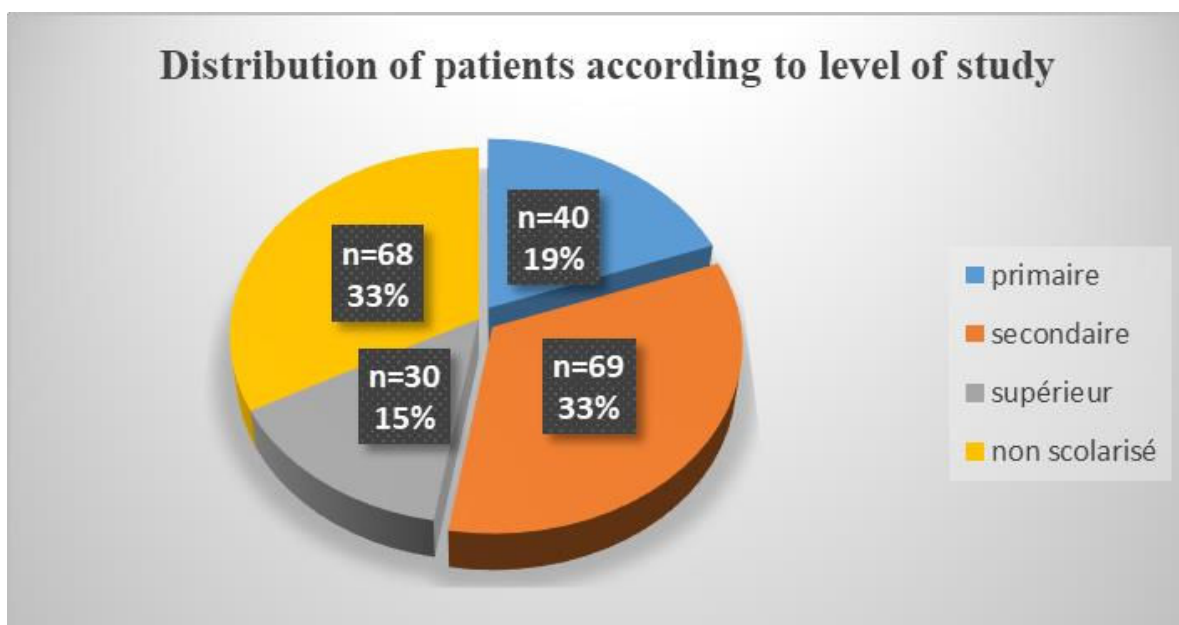


Figure 3: Distribution of patients according to level of study.

Distribution of Patients According to Reasons for Consultation

Cough was the main reason for consultation with 150 (72.5%) cases followed by chest pain 26 (12.6%) (Fig. 4).

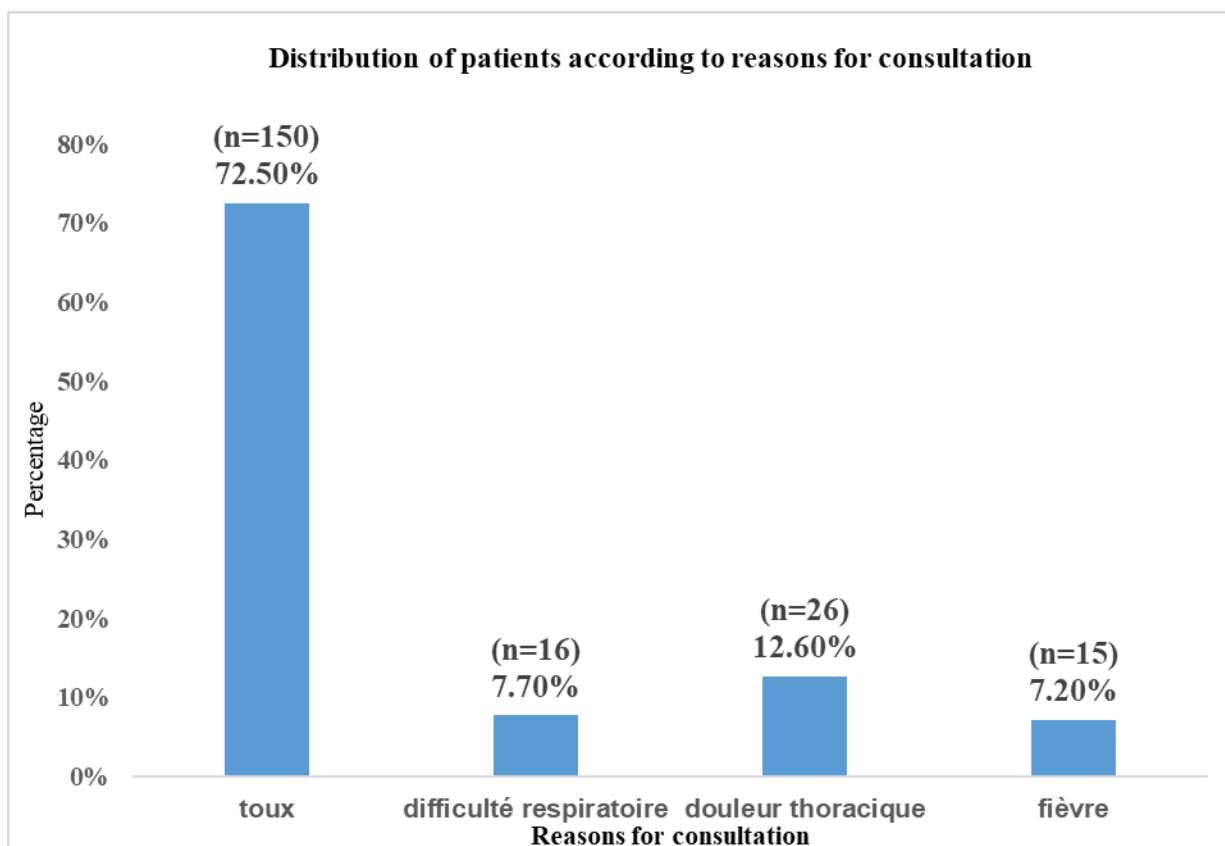


Figure 4: Distribution of patients according to reasons for consultation.

Distribution of Patients According to Macroscopic Aspects of Sputum

The appearance of the sputum was mucopurulent in 98 cases (47%), mucous in 87 cases (42%) and salivary in 22 cases (11%), respectively (Fig. 5).

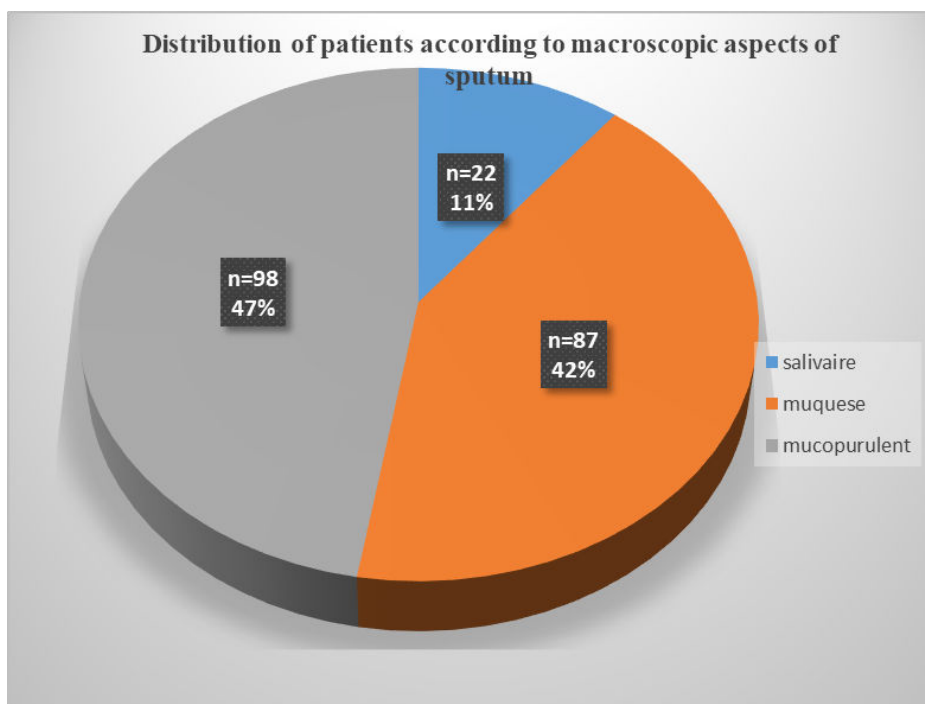


Figure 5: Distribution according to the appearance of the sputum.

Distribution of Patients According to Microscopic Aspects of Sputum

Table 4 shows the morphology of the pathogens responsible for pneumonia after GRAM staining. Gram+ Cocci in clusters represented 62 (45.25%) followed by Cocci in chains 41 (29.92%) and 34 (24.81%) Gram- bacilli.

Microscopic Aspects	Effective	%
Gram+ cocci in clusters	62	51.23
Gram+ cocci in chain	41	34
Gram- bacilli	18	15
Total	121	100

Table 4: Distribution of patients according to microscopic aspects of sputum.

Bacterial Etiology of Pneumonia

Of the 207 cultures performed, 121 bacterial agents were isolated in the sputum examined, giving a prevalence of bacterial pneumonia of 58.45% and 86 (41.54%) negative cultures ($\chi^2 = 1.853 < \chi^2_{0.05} < 3.84$, $q = 0.20$, $df = 1$, non-significant difference). Of the 121 bacterial agents isolated, 103 (85.12%) were Gram-positive bacteria and 18 (15%) Gram-negative bacteria ($\chi^2 = 9.104 > \chi^2_{0.05} > 3.84$, $q = 0.001$, $df = 1$, significant difference in favor of the predominance of Gram-positive bacteria).

The most frequent germs were *Staphylococcus haemolyticus* (38.02%) followed by *Streptococcus pneumoniae* (34%), *Staphylococcus aureus* (13.22%) and *Escherichia coli* (10%) (Table 5).

Bacterial Agents	Effective	%
<i>Staphylococcus haemolyticus</i>	46	38.02
<i>Staphylococcus aureus</i>	16	13.22
<i>Streptococcus pneumoniae</i>	41	34
<i>Escherichia coli</i>	12	10
<i>Haemophilus influenzae</i>	3	2.48
<i>Pseudomonas aeruginosa</i>	3	2.48
Total	121	100

Table 5: Distribution of isolated bacterial agents.

Evaluation of the Effectiveness of Antibiotics Tested Against Bacterial Agents

Table 6 shows the result of sensitivity testing of isolated bacterial agents to antibiotics. The proportions of resistance were completely variable. Among *Staphylococcus*, resistance was very remarkable with erythromycin (85.4%), oxacillin (77.4%) and ciprofloxacin (69.3%) respectively.

On the other hand, *Staphylococcus* were highly sensitive to fusidic acid. Oxacillin and amoxicillin clavulanic acid were almost inactive. The resistance of *Escherichia coli* remains relatively high with amoxicillin clavulanic acid (66.7%) and Ceftazidime (83.3%). On the other hand, *Pseudomonas aeruginosa* were all sensitive to Ceftazidime (100%). In short, in general, the sensitivity of isolated bacterial strains gradually decreases from aminopenicillins to 3rd generation cephalosporin. The importance of the sensitivity test allows the adaptation of antibiotic therapy to microbiological results.

Bacterial agents	Nb	Antibiotic															
		OXA		AMC		CRO		CAZ		IMP		ERY		CIP		AF	
		S (%)	R+I (%)	S (%)	R+I (%)	S (%)	R+I (%)	S (%)	R+I (%)	S (%)	R+I (%)	S (%)	R+I (%)	S (%)	R+I (%)	S (%)	R+I (%)
<i>S. haemolyticus</i>	46	14(30.4)	32(69.5)	17(37)	29(63)	28(61)	18(39)	NR		35(76.1)	11(24)	9(19.6)	37(65)	16(35)	30(69.3)	44(96)	2(4)
<i>S. aureus</i>	16	8(50)	8(50)	10(62.5)	6(37.5)	9(56.25)	7(43.75)	NR		12(75)	4(25)	11(68.75)	5(31.25)	9(56.25)	7(43.75)	15(93.75)	1(6.25)
<i>Str. pneumoniae</i>	41	16(39.0)	25(61)	13(31.8)	28(68.2)	30(73.1)	11(26.9)	27(65.9)	14(34.1)	36(87.9)	5(12.1)	7(17.0)	34(83)	11(26.9)	30(73.1)	38(92.7)	3(7.3)
<i>E. coli</i>	12	NR		4(33.3)	8(66.7)	9(75)	3(25)	2(16.7)	10(83.3)	9(75)	3(25)	NR		9(75)	3(25)	NR	
<i>P. aeruginosa</i>	3	NR		0(0)	3(100)	1(33.3)	2(66.7)	3(100)	0(0)	2(66.7)	1(33.3)	NR		1(33.3)	2(66.7)	NR	
<i>H. influenzae</i>	3	NR		2(66.7)	1(33.3)	3(100)	0(0)	2(66.7)	1(33.3)	2(66.7)	1(33.3)	NR		2(66.7)	1(33.3)	NR	
Total (%)	121	38(37)	65(63.1)	46(38)	75(62)	80(66.1)	41(33)	34(58)	25(42.4)	96(79.3)	25(21)	27(26.2)	76(74)	48(40)	73(60.3)	97(94.2)	6(6)
NR: Not Required; Nb: Number; S: Susceptible; R+I: Resistance; Oxa: Oxacillin; AMC: Amoxicillin-Clavulanic Acid; CRO: Ceftriaxone; CAZ: Ceftazidime; IMP: Imipenem; ERY: Erythromycin; CIP: Ciprofloxacin; AF: Fusidic Acid; Str. pneumoniae: Streptococcus pneumoniae; S. aureus: Staphylococcus aureus; S. haemolyticus: Staphylococcus haemolyticus; E. coli: Escherichia coli; P. aeruginosa: Pseudomonas aeruginosa; H. influenzae: Haemophilus influenzae																	

Table 6: Evaluation of the effectiveness of the antibiotics tested against the 121 bacterial agents isolated.

Discussion

Respiratory infections represent, based on all statistical data, the leading reason for consultation. In this study series, the prevalence of bacterial pneumonia was 58.45%. This result is higher than that of Ohlmann in 2017, who noted a prevalence of 29.2% and higher than that of Ouédraogo, et al., in 2017 in Ouagadougou who found a prevalence of 10.44% [19,20]. This could be explained on the one hand by the fact that the study settings are not the same and on the other hand by self-medication which would be the cause of low consultation rates.

Concerning age, which is an independent risk and severity factor for the occurrence of a lower respiratory infection, in this study, the age group most affected was that of 25 to 34 years followed by 65 years and over (12.1%), the average age was 40.9 years and the extremes were 9 and 96 years, with a sex ratio of 1.9. This result is comparable to that of Yajie Zhang in China in 2021 which found relatively high frequencies of 18.18% among infants aged 0-6 months and 20.48% among adolescents aged 12 to 18 years with [21]. This could be explained in our context on the one hand by the fact that the Chadian population is young and on the other hand by the fact that acute lower respiratory infections are pathologies preferably linked to the lifestyle of young people. The male predominance was 66%. This result is close to that of Ly F, in 2019 in Senegal which found 63.1% [22]. These variable frequencies could be linked to different environmental and methodological conditions.

Regarding the profession, housewives are the most affected by acute bacterial pneumonia with a frequency of 27.5%, followed by traders 24.2%. These results are superimposable to those of previous studies in Togo, Mali and Congo Brazzaville and elsewhere [23-25]. This could be explained by the socio-economic level which was mainly considered low. 79.7% were from urban areas. This result is close to that of Saharé F, et al., in Bamako in Mali in 2022 who found 79.1% [23]. This could be explained by the rural exodus which leads to a concentration of the population in the city and therefore promiscuity constituting a risk factor for bacterial acute respiratory infections.

Regarding clinical data, in this series, 8.7% of patient cases were immunocompromised (HIV+). This result is lower than that of Maître T, et al., in 2018, who reported 17.7% of cases of HIV infection [26]. This could be explained on the one hand by the fact that the study settings are different and on the other hand by the fact that this author only took into account Person Living with HIV (PLHIV) whereas we took into account all patients suffering from Acute Respiratory Infections (ARI). This result confirms the emergence of infectious respiratory pathologies in patients infected with HIV. They call for systematic screening for respiratory pathologies during the follow-up of these patients.

In this study series, 11.1% of patients were smokers and 4.8% were alcoholics. The results are comparable to previous studies carried out by Ouédraogo in Bamako, Mali in 2010 and Rudan I, et al., in 2013 [20,27]. These results show a relatively high rate of alcohol consumption. The high frequency of bacterial pneumonia is linked to chronic consumption of alcohol or tobacco and could be the cause of an alteration in the immune response of the patients surveyed.

Considering the para clinical data (Biology), microscopy after GRAM staining, culture made it possible to determine the most frequent bacteria isolated during cytobacteriological examinations of sputum (ECBC). *Staphylococcus* was strongly represented (51.23%) followed by *Streptococcus pneumoniae* (34%) of cases. *Pneumococcus* remains the most feared germ infecting patients of all ages due to its significant potential pathogenicity. This result is superimposable to that of Ouédraogo in Mali in 2010 which presented 32.6% and is higher than that of Fongoro in Mali in 2022 which found 5.7% and lower than that of Kane in Mali in 2020 which found 58.3% [20,24]. This could be explained by the fact that colonization by the respiratory tract differs depending on the time of year, particularly in spring.

In terms of systematic treatment after the result of the antibiogram, in this series, all patients are put on antibiotic therapy after the antibiogram carried out with imipenem in 82.6% of cases. This result is superimposable to the results of previous research [28,29]. Treatment with ceftriaxone was 63.6%, this result is lower than that of Kané in Mali in 2020 which found 83.3% [24]. Treatment with ceftazidime was 62.9% cases. This result is higher than that of Fongoro in Mali in 2022 which found 37.1% [23]. This could be explained by the low yield of additional investigations for the etiological diagnosis, meaning that the management of these infections remains above all empirical, with an early antibiotic taking into account the most common germs and the risk factor. Regarding the evaluation of the effectiveness of antibiotics, this study noted a gradual decrease in the sensitivity of aminopenicillins to 3rd generation cephalosporin of the bacterial strains isolated to the antibiotics tested. The resistance of all bacterial strains isolated was also very remarkable with erythromycin (74%), oxacillin (63.1%) and ciprofloxacin (62%). Oxacillin and amoxicillin clavulanic acid were almost inactive. The resistance of *Escherichia coli* remains high with amoxicillin clavulanic acid (66.7%). On the other hand, imipenem maintains the best activity followed by fusidic acid and ceftazidime.

The growing increase in resistance of bacterial strains could be explained by the misuse, illicit sale and prescription of antibiotics without laboratory evidence. Furthermore, several authors have observed resistance in strains of Gram-Negative Bacilli (GNB) and resistant pneumococci to beta-lactams, macrolides and fluoroquinolone [30-34].

Conclusion

The present study made it possible to determine a high prevalence of 58.45% of the bacteria responsible for acute typical pneumonia in patients admitted to the pulmonology and infectious diseases department as well as the characterization of the resistance profile to antibiotics commonly used for taking in charge of pneumonia in Chad. It appears from this study that acute typical pneumonia is much more common and occurs in most children and the elderly. This study also indicated that staphylococci and Streptococci are the most frequent and most incriminated germs in typical acute pneumonia, followed by *Escherichia coli*. The risk factors most associated with acute typical pneumonia are alcoholism and smoking. The most sensitive antibiotics are fusidic acid, Ceftazidime and imipenem. The most resistant antibiotics are erythromycin, oxacillin and ciprofloxacin. In view of these results, we recommend the prescription of antibiotics with the bacteriological results and advise the rational prescription of fucidine, imipenem and Ceftazidime for the treatment of typical acute pneumonia in our region.

Conflict of Interest

The authors have no conflict of interest to declare.

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