

## Treatment and Management of Bacterial Purulent Acute Otitis at the Bogodogo District Community Hospital, Burkina Faso, West Africa

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### Abstract

**Background:** This is a descriptive short report of a cross-sectional study conducted in the Otorhinolaryngology unit (ORL) of the Bogodogo district community hospital and in the Unit of Bacteriology/Virology of the National Laboratory of Public Health. This study sought to provide insight into the quality of antibiotic prescribing in patients with purulent acute otitis media (PAOM) to establish a better treatment and management of local population 'health.

**Methods and findings:** A cross-sectional investigation was carried out from June 2014 to January 2015. Here, we reported and included in the analysis 58 cases of antibiotic-naïve patients diagnosed with purulent acute otitis media seen in the otorhinolaryngology unit of the Bogodogo district community hospital. Thirty-one (31) patients were over 15 years. Males were the dominant group with a sex ratio of 1.3. Sixty-two (62) bacterial strains were isolated from patient samples of which *Staphylococci*, *Enterobacteriaceae* and *Pseudomonas* accounted for 37.1%, 32.2% and (22.6%), respectively. Among the antibiotics tested, four (4) classes proved effective: Gentamycin (98%), Ciprofloxacin (97%), Imipenem (82%) and the 3<sup>rd</sup> generation of Ceftriaxone (76%). However, the sensitivity to Ampicillin and Amoxicillin + clavulanic acid was very low.

**Conclusions:** Self-medicating, over-prescribing unnecessary drugs are among the cause of resistance to antibiotic treatment. We were able to identify the main bacteria involved in purulent acute otitis and hope this effort of generating data will be useful to improve the care for patient in Burkina and beyond in Sun-Saharan Africa.

**Keywords:** PAOM; Bacteria; Antibiotics sensitivity; Resistance; Burkina Faso

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### Introduction

Purulent acute otitis media (PAOM) refers to a group of inflammatory disease of the middle ear caused by either bacterial or viral infection, often characterized by a purulent or mucopurulent effusion in the tympanic body [1-3]. Along with nasopharyngitis, PAOM is one of the leading causes of antibiotic prescriptions in children [3-5]. In Burkina Faso, ear infections are among the top 10 reasons for consultation in medical centers [6]. In 2012, the otorhinolaryngology unit (ORL) of the Bogodogo district community hospital reported 542 cases of PAOM with

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41.1% (223) of patients aged 14 years and older [7]. Infection of the middle ear can in chronic and complicated forms affect some of the organs near the mastoid cavities including the facial nerve or the inner ear but also extend to the skull and cause neurological disorders [8].

Unfortunately, the increasing number of PAOM cases is correlated with the increase of antibiotic-resistant bacterial strains due in large part to extensive unnecessary prescriptions [9]. Indeed, in the 1950s, the supposedly bacterial origin of PAOM led to the systematic prescription of available antibiotics, which caused the emergence of antibiotic-resistant germs and therapeutic failures [10]. This situation has led to a complete reformulation of the treatment regimens, including the choice of molecules to be prescribed in developed countries such as France. As a direct consequence, the French agency for health products Security (AFSSAPS) has developed a guideline of recommendations to standardize the management of acute otitis media to further reduce the rate of bacterial resistance [10]. According to the agency, the main causative organisms are *Streptococcus pneumoniae*, *Haemophilus influenzae*, *Moraxella (Branhamella) catarrhalis*, while studies in sub-Saharan African countries, particularly in Burkina Faso, have found that the main germs observed were enterobacteria, staphylococci and *Pseudomonas* [1]. In Sub-Saharan Africa, the odds that patients would be prescribed the wrong antibiotic are higher than anywhere else due to the lack of national regulations that direct physicians, variations in bacterial epidemiology and strains [11]. Therefore underlying the need of constantly update healthcare workers in current bacterial species that are treatment resistant. This study aimed to provide relevant clinical data on antibiotic-resistant germs for the treatment of PAOM with the goal of improving patient outcomes in Burkina Faso.

## Materials and Methods

### Patients' recruitment

This was a cross-sectional descriptive study that focused on the ear pus collections of patients consulted in the ORL of the Bogodogo district community hospital from June 2014 to January 2015. These samples were analyzed at the National Laboratory of Public Health. Patient's informed consents were obtained in a written form from adults or guardians. Sampling was non-probabilistic, patients were systematically recruited when the diagnosis of PAOM was made and there was no ongoing antibiotic therapy. A sample of pus was collected using two sterile cotton swabs. One was used to make smears for fresh microscopic examination and Gram staining and the other for bacterial culture.

### Bacteria isolation and identification

The bacteriological examination consisted of making

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cytobacteriological analysis of the ear pus samples. These analyze included macroscopic and microscopic examination.

Contamination-free bacteria growth media was used to isolate colonies. Samples were seeded on a brain heart infusion broth and incubated at 37°C for 24 hours. Suspected germs were re-seeded on a specific agar. Chocolate Agar with IsoVitalax was used for *Haemophilus influenzae*, *Moraxella catarrhalis* and *Staphylococcus*. Eosin Methylene Blue (EMB) for Gram-negative Enterobacteriaceae and Gram-negative Bacilli. Other media such as Cysteine Lactose Deficient in Electrolytes (CLED), DNase, Müller Hinton (MH), Sabouraud, and Chapman were used depending on the Gram results and the results of the primary culture. Experiments were carried out following the European Society of Clinical Microbiology and Infectious Diseases guidelines. Bacterial isolation and identification were performed based on morphological, cultural, biochemical and antigenic features.

In the presence of Gram-positive cocci, catalase status detected (with hydrogen peroxide) to differentiate between streptococci and staphylococci (staphylococci are catalase producers). Thus negative catalase indicates the presence of Streptococci and positive catalase will most likely indicate the presence of staphylococci. To further confirm the presence of Staphylococci, a Chapman medium was used along with DNase test. *S. aureus* is Chapman, Mannitol and DNase positive. Chapman contains mannitol, 7.5% NaCl and phenol red as a pH indicator. It is red in color but can turn yellow when mannitol is fermented by *S. aureus*. *S. saprophyticus* is Chapman and Mannitol positive finally *S. epidermidis* is Chapman positive. For Gram-negative bacilli: an oxidase test was performed to distinguish between Enterobacteria on the one hand, and *Pseudomonas* and *Haemophilus* on the other hand.

When the oxidase is positive, a re-isolation is done on the CLED agar (Cystine-Lactose-Electrolyte-Deficient Agar) for the research of *Pseudomonas aeruginosa* (makes it possible to better visualize the appearance of a green coloring: pyoverdine). The identification is confirmed by the determination of the biochemical characteristics using the API 20 E gallery (Bio-Mérieux). The growth factors X and V were used when the presence of *Haemophilus* was suspected (coco bacilli or Gram-negative polymorphic bacilli).

The antibiotic sensitivity screening used the KIRBY-Bauer method using diffusion on agar medium, according to guidelines (2013) of the French Society of Microbiology AntibioGram Committee (CA-SFM).

### Statistical analysis

The data was recorded with Microsoft office Excel 2017 and analyzed with the CSpro version 5.0.

### Ethical considerations

This study was approved by the National Public Health Laboratory of Burkina Faso Ethics Committee. Informed consent was obtained from adults and parents or guardians of individuals under 18 years old.

## Results

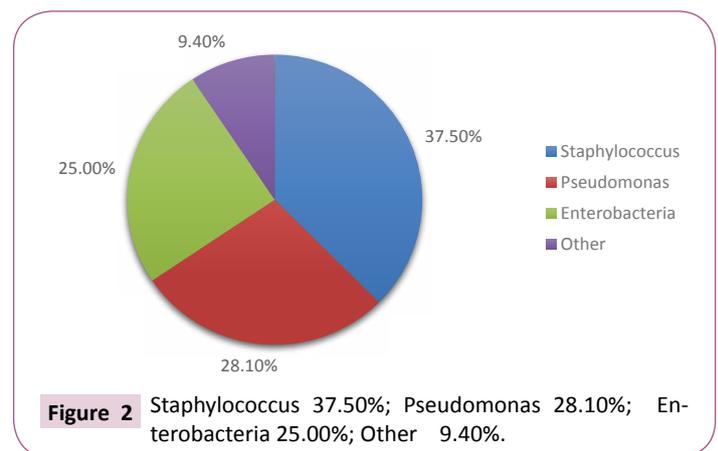
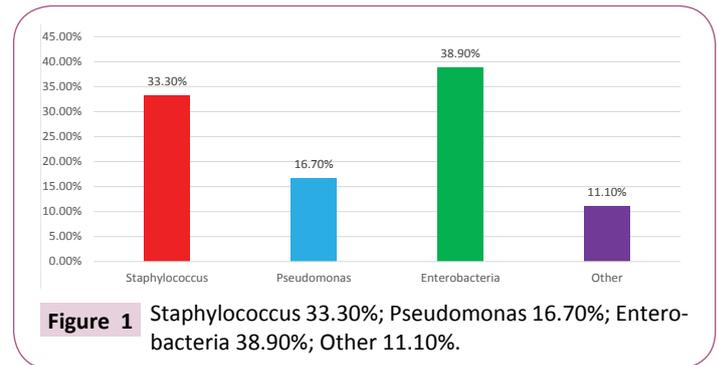
For eight months, 64 cases of acute purulent otitis media were collected at the ORL department of the Bogodogo district hospital. Patients were aged from 1 month to 70 years with an average age of 22 years and a sex ratio of 1.32. The majority Patients were over 15 years of age (53.4%), followed by children under the age of 04 who accounted for almost a quarter of the sample (25.9%). Of the 64 samples from PAOM 62 had a positive culture with 96.9% of positivity rate. A total of 62 bacteria (13 bacterial species) and six (06) yeasts were identified.

Most of the bacteria observed were Staphylococci (37.1%), followed by Enterobacteriaceae (32.2%) and Pseudomonas (22.6%) **Table 1**. When considering age, Enterobacteriaceae were predominant in patients younger than 4 years **Figure 1** and Staphylococci were predominant in patients over the age of 15 **Figure 2**. Among the bacterial species, whatever the age, *Staphylococcus aureus* (35.5%) was the predominant species, followed by *Pseudomonas aeruginosa* (16.1%) and *Escherichia coli* (11.3%).

In general, isolated bacteria had good sensitivities for four (4) antibiotics, namely Ciprofloxacin (97%), Gentamicin (98%), Imipenem (82%) and Ceftriaxone (76%). The sensitivity to other antibiotics was 47% for Cotrimoxazol, 3% for Ampicillin and 18% for Amoxicillin + clavulanic acid. In spite of the latter, there was a strong resistance noted with the use of Ampicillin (94%), Erythromycin (77%) and Amoxicillin + Clavulanic acid (74%). Depending on the organisms, susceptibility to antibiotics varied from one bacterium to another. Staphylococci were sensitive to Ciprofloxacin (100%), Gentamicin (100%) and Ceftriaxone (96%). However, their sensitivity was low with the antibiotics commonly used in particular with Ampicillin (00%), Amoxicillin

**Table 1** Bacterial repartition by age.

	0-3 years	4-6 years	7-14 years	≥ 15 years	Total
<i>Staphylococcus</i>	6	5	0	12	23
<i>Pseudomonas</i>	3	1	1	9	14
<i>Enterobacteries</i>	7	5	0	8	20
Other	2	0	0	3	5
<b>Total</b>	<b>18</b>	<b>11</b>	<b>1</b>	<b>32</b>	<b>62</b>



plus (+) clavulanic acid (17%) and 57% with Cotrimoxazol. Enterobacteriaceae showed 100% sensitivity to Gentamicin, 95% to Ciprofloxacin, 85% to Imipenem, 60% to Cotrimoxazol, 10% to Ampicillin, and 35% to Amoxicillin + clavulanic acid. If all Pseudomonas were sensitive to Ciprofloxacin, none was affected by Ampicillin and Amoxicillin + clavulanic acid. However, we obtained a sensitivity of 64% to Ceftriaxone, 42% to Imipenem, 93% to Gentamicin and 7% to Cotrimoxazol.

For the other bacteria, no sensitivity was noted with Ampicillin and Amoxicillin + clavulanic acid. Also, their sensitivity were 100% to Gentamicin, 80% to Ciprofloxacin and Imipenem, 60% to Cotrimoxazol and 20% to Ceftriaxone.

In our sample, bacterial associations were observed. Those associations involved *Staphylococcus aureus* with four bacteria and one yeast **Table 2**.

**Table 2** Observed bacterial associations.

Associations	Number
<i>Staphylococcus aureus</i> + <i>Candida Sp</i>	3
<i>Staphylococcus aureus</i> + <i>Escherichia coli</i>	2
<i>Staphylococcus aureus</i> + <i>Acinetobactersp.</i>	1
<i>Staphylococcus aureus</i> + <i>Klebsiella pneumoniae</i>	1
<i>Staphylococcus aureus</i> + <i>Enterobacter sp.</i>	1

## Discussion

In the present study, male patients were the most represented, with 56.9% of cases, and a sex ratio of 1.32. According to database of Burkina Faso Ministry of Health, the same observation was done with a higher sex ratio (1.8) [6]. Of the 64 cultures performed, the positivity rate was 96.9%. This high rate is partly related to the conditions of inclusion in our study which only took into account patients without antibiotic therapy. This strong crop positivity has also been observed in other studies with the same positivity rate [2].

Generally speaking, the most common germs were Gram-negative bacilli, about 63%. This predominance is due to the fact that they constitute a great variety of bacteria and are the most encountered in human pathologies.

The present study found that Micrococaceae were the most bacteria represented (37.7%), followed by Enterobacteriaceae (29.5%), and Pseudomonaceae (23.0%). It is the same as that reported in Senegal by Cisse et al. who found a predominance of Micrococaceae (37%), followed by Enterobacteria (26%), and Pseudomonaceae (25%) [3]. However, Ghanpur et al. revealed predominance of *Pseudomonas aeruginosa* (33%), Methicillin Resistant *Staphylococcus aureus* (MRSA) (18%) [12]. In another study in Chile, *Streptococcus pneumoniae* and *Haemophilus influenzae* were predominant [13].

Concerning the bacterial species involved in this infection recall that according to the AFSSAPS, *S. pneumoniae* (25 to 40%), *H. influenzae* (30 to 40%) and *M. catarrhalis*. *S. pyogenes* (group A streptococcus) are the main bacteria involved in purulent AMO of children over 3 months of age and *S. aureus* played a minor role (<5%) [10]. However, *Staphylococcus aureus* was the most commonly encountered bacterial species in our series (35.5%), followed by *Pseudomonas aeruginosa* (16.1%) and *Escherichia coli* (11.3%). In addition, no cases of *pneumococcus*, *Haemophilus* or *Moraxella* were isolated. This is in line with other work carried out in Africa, notably in Senegal [3]. This difference would be associated, on the one hand, with the bacterial ecosystem varying from one continent to another, sampling and manipulation techniques given the fragility of these germs and, on the other hand, the role of vaccination in reducing of the circulation of these two germs in Burkina Faso. As part of the Expanded Program routine on Immunization (EPI) in Burkina Faso, children have

been receiving free vaccination against *Haemophilus influenzae B* and against *Streptococcus pneumoniae*, since 2013.

In comparison with the susceptibility of the organisms to the antibiotics tested, the study showed low sensitivities of staphylococci, enterobacteria and *Pseudomonas* with respect to ampicillin and Amoxicillin plus clavulanic acid. This strong resistance of these germs to the molecules has been observed in the country and which could be associated with a production by these  $\beta$ -lactamase bacteria [6]. Ciprofloxacin, Gentamicin and Imipenem were very active on *Staphylococcus aureus*, *Escherichia coli* and *Pseudomonas aeruginosa*. Cissé et al. also showed a high sensitivity of *Pseudomonas aeruginosa* to Ciprofloxacin and to Gentamicin [3]. In general, four antibiotics showed good activity on the 62 isolated bacteria: Ciprofloxacin (97%), Gentamicin (98%), Imipenem (82%) and Ceftriaxone (76%). Low sensitivities were observed with Ampicillin (3%), Erythromycin (21%) and amoxicillin plus clavulanic acid (18%) and Cotrimoxazole (47%). This lower sensitivity of bacteria to cotrimoxazole could occur its frequent use in the management of opportunistic infections with the advent of HIV. These low sensitivities could be due to selection pressure and  $\beta$ -lactamase production. In fact,  $\beta$ -lactams, in particular amoxicillin and the amoxicillin/ clavulanic acid combination, are commonly used antibiotics because of their greater accessibility (cost and availability) and are also well known to prescribers. This would encourage consumption and possible self-medication.

## Conclusion

This study allowed us to determine the main bacteria responsible for acute purulent otitis media at the Bogodogo district hospital and their susceptibility profile to antibiotics most commonly used in our context.

These infectious agents, because of the frequent and probabilistic prescription of antibiotics in infections of the ORL sphere, are subjected to a strong selection pressure. Monitoring the evolution of resistance ensures the success of a probabilistic treatment especially in Burkina Faso where the bacteriological examination is not systematically asked in the presence of a bacterial infection. Knowledge and updating of data on bacterial epidemiology and antibiotic susceptibility profiles of the most isolated bacteria are essential.

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## Conflict of Interest Statement

The authors declare no conflict of interest.

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