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Antimicrobial profiles of bacterial clinical isolates from the Gabonese National Laboratory of Public Health: data from routine activity

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SUMMARY

Background: The present study is one of the first to provide a picture of antimicrobial resistance for a range of bacteria and antimicrobial classes in Gabon, Central Africa.
Methods: During the year 2010, 146 urine cytology, 143 blood cultures, 107 vaginal swabs, 23 urethral swabs, and 18 other culture examinations were positives. All isolates were tested for antibiotic sensitivity.
Results: Four hundred thirty-seven microorganisms were isolated: 210 enterobacteria, 166 staphylococci, 38 streptococci, 14 Acinetobacter, and nine Stenotrophomonas. Of the Klebsiella isolates, 18% and 30% were found to be resistant to selected third-generation cephalosporins (3CG) and fourth-generation cephalosporins (4CG), respectively. Sixty-seven percent of *Escherichia coli* isolates were resistant to amoxicillin with clavulanic acid. Between 3% and 30% of *E. coli* isolates were resistant to selected 3CG. All *Enterobacter cloacae* isolates were sensitive to imipenem. Resistance to quinolones/fluoroquinolones was seen in 21–50% of *E. coli* isolates. Twenty-six percent of *E. cloacae* showed resistance to ceftazidime and 37% to cefotaxime. The resistance rate to quinolones ranged between 58% and 78%. Thirty-two percent of Staphylococcus isolates were resistant to gentamicin. Low resistance rates to teicoplanin (2–4%) were observed. Thirty-seven percent of isolated *Staphylococcus aureus* and 61% of isolated *Staphylococcus saprophyticus* were resistant to both penicillin G and oxacillin. Streptococcus isolates had low resistance rates to erythromycin, ceftriaxone, and ciprofloxacin (5%, 7%, and 14%, respectively) and were highly resistant to tetracycline, gentamicin, and sulfamethoxazole–trimethoprim (92%, 91%, and 62%, respectively).
Conclusions: The antimicrobial resistance profiles seen here are of concern. To control the spread of drug-resistant bacteria, clinicians should be cognizant of their local antimicrobial resistance patterns.

1. Introduction

In developing countries, the spread of antimicrobial resistance is a matter of concern as its compromises the management of infectious diseases, the leading causes of morbidity and death in these countries.[1–3] Existing data show that there is an association between antimicrobial resistance and increased mortality, morbidity, and healthcare costs.[4–6]

The excessive use of antimicrobials produces selective pressure for resistance.[7,8] Also, empirical treatment with ineffective antibiotics prescribed by physicians and poor patient adherence to antibiotic regimens could potentially lead to mutation and drug resistance.[7,8] Furthermore, the routine use of antibiotics in animal foods to promote their growth is another aspect that may enhance selective pressure for resistance.[9,10]

Roberts et al., reported that significant health and economic benefits could be realized through effective interventions to reduce antimicrobial-resistant infections.[6] Antibiotic susceptibility testing is a key indicator in the design of effective interventions for rational antibiotic use.[11,12] The reporting of antibiotic susceptibility testing results by clinical laboratories is required for the surveillance of emerging resistance and the development of appropriate prescription guidelines.[6,8,11–13]

Our study is one of the first and unique efforts to provide a broad picture of antimicrobial resistance for a range of bacteria and antimicrobial classes in Central Africa (Gabon). Resistance to

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first- (1CG), second- (2CG), third- (3CG), and fourth-generation cephalosporins (4CG), macrolides, penicillin, quinolones, sulfonamides and associates, tetracycline, and others were assessed for *Enterobacteriaceae*, staphylococci, and streptococci.

2. Methods

This study was carried out at the Gabonese National Laboratory of Public Health in Libreville. The National Laboratory of Public Health is the largest laboratory among the few in the country equipped to carry out bacteriological tests. We believe that the data presented here represent the situation in Libreville (over 40% of the Gabonese population lives in Libreville). The National Laboratory of Public Health managed 9035 patients in its bacteriology service in 2010. Hospitalized patients represented 12% and ambulant patients 88% of patients seen.

Four hundred thirty-seven microorganisms were isolated from 146 urine cultures, 143 blood cultures, 107 vaginal swabs, 23 urethral swabs, and 18 other culture examinations. All isolated organisms were tested for antibiotic sensitivity (the list of antibiotics tested is given in Table 1).

The identification of microorganisms was done using bioMérieux API bacterial identification test strips (bioMérieux, France). All tests were done in accordance with the manufacturer's instructions and protocols. bioMérieux API 20E or API 10S strips (bioMérieux, France) were used for the identification of *Enterobacteriaceae*, whereas staphylococci and streptococci were identified by bioMérieux API kits for *Micrococcaceae* (Slidex kits were used for the confirmation of *Staphylococcus aureus*). The analysis of antibiotic resistance was done in accordance with the French Society of Microbiology guidelines. Sensitivity testing was done using both bioMérieux ATB test strips (ATB G, ATB UR, ATB-Staph, and ATB-Strep; bioMérieux, France) and the BioRad agar disk diffusion method (BioRad, Marnes-la-Coquette, France). High-level aminoglycosides were used for Streptococcus sensitivity testing. Resistance to amoxicillin, aztreonam, and at least two of the following antibiotics: cefuroxime, ceftazidime, cefotaxime, ceftriaxone, and cefepime, was an indicator of probable extended-spectrum beta-lactamase (ESBL) strains,[14–16] whereas resistance to both penicillin G and oxacillin indicated a methicillin-resistant-like profile.[17]

All patients gave their consent after being informed that the results of their antimicrobial sensitivity testing would be reported for scientific and epidemiological surveillance purposes. The review board of the National Laboratory of Public Health approved the study protocol.

Table 1
Antibiotics used for sensitivity testing

Penicillins	Penicillin G (P)
	Amoxicillin (AMX)
	Amoxicillin with clavulanic acid (AMC)
	Oxacillin (OX)
	Ticarcillin (TIC)
	Ticarcillin–clavulanic acid (TCC)
	Piperacillin (PIP)
	Piperacillin–tazobactam (TZP)
Monobactams	Aztreonam (ATM)
First-generation cephalosporins	Cefalotin (CF)
Second-generation cephalosporins	Cefuroxime (CXM or FUR)
	Cefoxitin (FOX)
Third-generation cephalosporins	Cefotaxime (CTX)
	Ceftazidime (CAZ)
	Ceftriaxone (CRO)
Fourth-generation cephalosporins	Cefepime (FEP)
Aminoglycosides	Kanamycin (K)
	Gentamicin (GM)
	Tobramycin (TOB)
	Netilmicin (NET)
	Amikacin (AN)
Fosfomycin	Fosfomycin (FOS)
Rifampin	Rifampin (RA)
Phenicols	Chloramphenicol (C)
Quinolones/fluoroquinolones	Nalidixic acid (NA)
	Norfloxacin (NOR)
	Plefloxacin (PEF)
	Ofloxacin (OFX)
	Ciprofloxacin (CIP)
	Levofloxacin (LEV)
Macrolides	Lincomycin (L)
	Erythromycin (E)
	Clindamycin (CC)
	Spiramycin (SP)
	Pristinamycin (PR)
Glycopeptides	Vancomycin (VA)
	Teicoplanin (TEC)
Sulfonamides and associates	Sulfamethoxazole with trimethoprim (SXT)
	Triple sulfa (SSS)
	Trimethoprim (TMP)
Tetracyclines	Minocycline (MNO)
	Tetracycline (TE)
Others	Colistin (CS)
	Fusidic acid (FA)
	Linezolid (LNZ)
	Minocycline (MNO)
	Nitrofurantoin (FT)
	Telithromycin (TEL)
	Imipenem (IPM)

3. Results and discussion

Resistance to antimicrobial agents has become a major healthcare problem. Clinicians should be cognizant of their local antimicrobial resistance patterns in order to be more efficient in dealing with bacterial infections and to prevent the spread of drug-resistant bacteria. The present study is the first to provide a picture of antimicrobial resistance for a range of bacteria and antimicrobial classes in Central Africa, particularly in Gabon.

In this study, 437 microorganisms were isolated: 210 enterobacteria, 166 staphylococci, 38 streptococci, 14 Acinetobacter, and nine Stenotrophomonas (detailed in Table 2). Observed sensitivity profiles are shown in Tables 3–5.

Enterobacteriaceae are among the leading causes of community-onset bacterial infections.[3] Beta-lactams and fluoroquinolones are the principal antibiotic classes used to treat enterobacteria infections. Here we found that a quarter of isolated *Klebsiella spp* were resistant to amoxicillin with clavulanic acid. *Klebsiella spp* resistance to gentamicin and cephalosporins is of concern. More than half of the isolated *Klebsiella spp* were resistant to gentamicin; 18%, 30%, 26%, 33%, 51%, 60%, and 79% of isolated *Klebsiella spp* were resistant to cefepime (4CG), tazobactam (beta-lactamase inhibitor), ceftazidime (3CG), cefotaxime (3CG), cefoxitin (2CG), cefuroxime (2CG), and cefalotin (1CG), respectively; 18%, 28%, 32%, and 54% of isolates were resistant to ciprofloxacin, ofloxacin, norfloxacin, and nalidixic acid, respectively. All isolates of *Klebsiella spp* were sensitive to the carbapenem antibiotic imipenem. Our data suggest that in our setting selected fluoroquinolones/quinolones and selected fourth- and third-generation cephalosporins could be more effective than gentamicin, but less effective than imipenem in treating *Klebsiella spp* infections.[15]

For a number of antibiotics, we found that the rates of resistant strains of *Escherichia coli* in our setting were higher than those reported in other studies.[18–20] Ninety-one percent of isolates were resistant to amoxicillin; the resistance rate to the combination amoxicillin and clavulanic acid was 66%. Imipenem, aztreonam (3CG), amikacin, and ceftazidime (3CG) maintained high activity; more than 85% of *E. coli* isolates were sensitive to these antibiotics. The same results were observed in other studies.[21,22] Resistance to